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EVALUATION OF RED PINE PLANTATION FAILURES ON THE SUPERIOR NATIONAL FOREST, 1978

by

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INTRODUCTION

The failure of red pine plantations within the first year after outplanting has been common in Minnesota on the Superior and Chippewa National Forests since 1967. Cooley (1974) and Skilling[1/] showed that much of the loss of the red pine was due to improper handling of stock and poor planting practices. Anderson and others (1976) showed that root rot organisms (Cylindrocladium sp., Sclerotium bataticola, Fusarium oxysporum) and a lack of mycorrhizae were the major causes of death.

Exceptional losses of red pine planted both in the fall of 1977 and the spring of 1978 prompted a request by the timber management staff of the Superior National Forest for a reevaluation by State and Private Forestry of the causes of these red pine outplanting failures.

OBJECTIVE

The objective of the investigation was to determine the causes of red pine seedling deaths in areas planted in the fall of 1977 and the spring of 1978 on the Superior National Forest.

METHODS

Outplanted red pine seedlings were examined on 11 plantations on the Virginia, Tofte, and Kawishiwi Ranger Districts of the Superior National Forest. The plantations had been previously examined by district personnel for seedling survival and were selected because mortality was in excess of 30 percent. Ten to 20 affected seedlings in each plantation were examined in the field to determine possible causes of death.

[1/] Skilling, Darroll D. 1976. Eveleth Nursery stock mortality study, Progress Report No. 1, available from the North Central Forest Experiment Station, St. Paul, Minn.

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Representative seedlings were taken to the laboratory for isolation of possible pathogens and determination of shoot-to-root ratios. In one plantation, in which root rot was suspected as the cause of seedling death, soil samples were taken adjacent to both affected seedlings and non-affected seedlings and from an area 10 ft. from the affected seedlings. The soil was analyzed to determine if root rot pathogens were present in the natural forest soils.

RESULTS AND DISCUSSION

The plantation failures were not due to any single factor. The major causes of death were root rot, poor planting practices, damage to the stock before planting, poor shoot-to-root ratios, and a lack of mycorrhizae.

Root rot caused seedling deaths in three plantations on the LaCroix Ranger District and in one plantation on the Virginia Ranger District. The root systems of the affected seedlings in these plantations exhibited the typical symptoms of root rot, and Fusarium oxysporum was isolated both from the roots and from the soils adjacent to the roots of the affected seedlings. This fungus was not isolated from other areas in the plantation. These results agree with the findings of Smith (1967), who showed that most Fusarium species are not found in natural forest soils.

Poor planting, the second and relatively minor cause of losses, was responsible for the deaths in one plantation that was examined. Dead seedlings were concentrated in one row, and they could easily be pulled from the planting hole because the soil had not been compacted around the seedling.

A third factor, damage to the stock before it was planted, caused losses in three plantations. In one case the stock was purchased from an agency that had insufficient storage capacity to keep the stock refrigerated from the time it was lifted until it was picked up. Thus, some seedlings flushed and others dried out before planting, and survival was reduced. In other cases the stock was held unrefrigerated in the field too long before planting.

Finally, poor shoot-to-root ratios and a lack of mycorrhizae caused poor survival in three plantations. Many seedlings on the Tofte and Virginia Ranger Districts had shoot-to-root ratios of 4/1 and 5/1. Present guidelines for grading conifers of the Lake States suggest that seedlings with a 5/1 shoot-to-root ratio are borderline and could suffer if subjected to stress (Stoeckeler and Jones 1957). In some cases roots were apparently overpruned at the nursery, thus requiring a sparse 4-inch- to 6-inch-long root system to support a dense, 8-inch top. Many of the root systems also lacked mycorrhizae, further decreasing the nutrient- and water-absorbing capacity of the seedlings.

RECOMMENDATIONS

Most of the problems noted in this evaluation are not new. They were observed in previous evaluations by other personnel and organizations. We can minimize our losses by following these precautionary measures:

1. Use the proper fumigation techniques in the nursery to control root rot pathogens. Total coverage of the area to be fumigated is as important as proper rates of application of the fumigant.

2. Follow the proper fertilization schedules to produce seedlings with satisfactory shoot-to-root ratios and adequate mycorrhizal levels. An excess of nutrients as well as a deficiency can produce seedlings of poor quality. High phosphorus levels (greater than 150 lb P_2O_5 per acre) decrease mycorrhizal levels, and high rates of nitrogen (definitive rates are being determined) applied within 2 months of seedling emergence can cause an increase in root rot (Rowan 1970, Sinclair et al. 1975).

3. Do not overprune roots of the seedlings. Overpruning increases the shoot-to-root ratio and reduces the chances for survival of the seedlings.

4. Provide sufficient training and supervision for planting crews.

5. Provide proper storage conditions for stock between lifting and planting.

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LITERATURE CITED

Anderson, Robert L., Sagar V. Krupa, Paul R. Laidly, and Elwin Stewart
1976. Evaluation of ectomycorrhizae on red pine seedlings at Toumey and Eveleth forest nurseries in the Lake States. USDA For. Serv., Northeast. Area, State and Priv. For. Eval. Rep. S-14-76. 10 p.

Cooley, John H.
1974. Planting technique and care of stock affect survival of planted red pine. USDA For. Serv., North Cent. For. Exp. Stn., Res. Note 159. 4 p.

Rowan, S. J.
1970. Soil fertilization, fumigation, and temperature affect severity of black root rot of slash pine. Phytopathology 61:184-187.

Sinclair, W. A., D. P. Cowles, and S. M. Hee
1975. Fusarium root rot of Douglas-fir seedlings: Suppression by soil fumigation, fertility management, and inoculation with spores of the fungal symbiont Laccaria laccata. For. Sci. 21:390-399.

Smith, Richard S., Jr.
1967. Decline of Fusarium oxysporum in the roots of Pinus lambertiana seedlings transplanted to forest soils. Phytopathology 57:1265.

Stoeckeler, J. H., and G. W. Jones
1957. Forest nursery practice in the Lake States. USDA For. Serv., Agric. Handb. 110. 124 p.